Artificial Cognition for Human-robot Interaction

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ABSTRACT

Human-robot interaction can increase the challenges of artificial intelligence. Many domains of AI and its effect is laid down, which is mainly called for their integration, modelling of human cognition and human, collecting and representing knowledge, use of this knowledge in human level, maintaining decision making processes and providing these decisions towards physical action eligible to and in coordination with humans. A huge number of AI technologies are abstracted from task planning to theory of mind building, from visual processing to symbolic reasoning and from reactive control to action recognition and learning. Specific human-robot interaction is focused on this case. Multi-model and situated communication can support human-robot collaborative task achievement. Present study deals with the process of using artificial intelligence (AI) for human-robot interaction.

Keywords: Artificial intelligence, internet of things, human-robot interaction, decision making, Deliberative Layer.

1. INTRODUCTION

Artificial intelligence is faced with various kinds of challenges due to this human-robot interaction, such as part and dynamic unknown devices that are meant for robots. Individual cognitive knowledge and strategies are important to maintain these challenges. Perspective-taking and affordance analysis processes can be left an impact on geometric reasoning and situation assessment. For multiple agents (humans and robots, with their specifications) acquisition and representation of knowledge are important in this case. Artificial cognition can provide information about knowledge management and human-robot interaction. High-quality cognitive skills can maintain the knowledge model of human-robot interaction. The human-aware deliberative layer is important to maintain the architecture and knowledge model of human-robot interaction. This paper has been described as knowledge management, both symbolic and geometric to neutral human-robot interaction.

2. HUMAN-ROBOT INTERACTION CONTEXT

Humans and robots can exchange information with the help of multiple modalities (mainly deictic gesture, verbal communication, and social gaze). Besides, interactive object manipulation is achieved by a robot, and by taking into account robot can fetch and carry tasks as well similar chores, this process is conducted in every stage, the belief, perspective, skill, and knowledge of the robot's human partner. Robots try to participate, understand, and recognize communication situations (Lemaignan et al. 2017). A robot is also involved in joint action, both implicit (the human points to an object) and explicit (the robot is addressed verbally by a robot) process is maintained in this case. Few important challenges are observed in human-robot interaction such as human-aware execution, communication, and joint action.

3. BUILDING A HUMAN-AWARE DELIBERATIVE LAYER

Multiple independent software modules are considered coherent robotic architecture. It is considered as a technical challenge as well as it is also an effective challenge for architecture and design. It is observed that, if robots can rely internally on human-level semantics then it is easy to maintain human-level-interaction. Using a first-order logic statement software component of artificial cognition can communicate with each other, this process is manipulated by humans. Geometric reasoning module involved in the production of high-frequency symbolic assertion, state of robot environment is described by this factor. This statement is stored in a knowledge vase and quid back with the presence of language processing module (DIALOGS), execution controller (HATP), and symbolic task planner (SHARY or PYROBORS). This architecture overview is provided in figure 1.
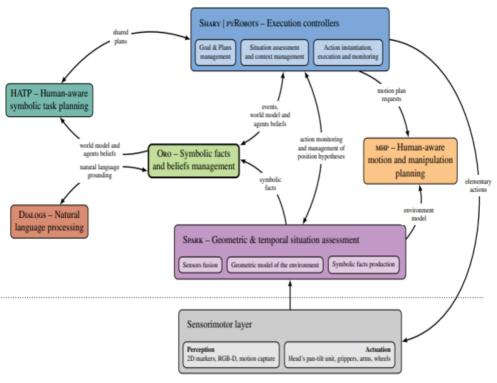
Figure 1: Architecture
(Source: Aly et al. 2017, p.315)

4. BIOLOGICAL INSPIRED ARCHITECTURE

ACT-R is mainly treated as a well-known cognitive architecture, this model is extracted from Anderson's model of human cognition. The separation between two types of knowledge is treated as a main and important assumption, these two types of knowledge are procedural and declarative. Due to the presence 018of sufficient activation, this system can increase awareness about the importance of knowledge (Williams et al. 2018). CLARION is considered as an effective biological architecture which depends on neural networks. The difference between implicit and explicit is maintained by this process and justify interaction between implicit and explicit processes. This process is implemented in AI applications, simulation processes of social physiology, and cognition. Based on the biological theory of attention ASMO has developed recently. Competing possible incompatible robot goals are solved by this model. Relative Priorities of goals are involved in the determination of attention. A bear robot interaction with humans is also maintained by this process.

Various artificial intelligence architectures are used in this case to solve effective problems. SOAR is considered an AI symbolic architecture that is involved in the problem-solving process. Short-term working memory and long term memory is present in this AI symbolic architecture. The reinforcement system is implemented when knowledge is inadequate to make any decision (Admoni and Scassellati 2017). SOAR is involved in the extension of emotions and maintaining the learning process. ICARUS is implemented in cognitive psychology and AI, reactive and deliberative problem-solving factors are unifying by this process. Along with this, symbolic and reasoning factors are also maintained by this process. Main goal of human-robot interaction is evaluated by this process. ICARUS consists of various skills about short-term memory and long-term memory.

5. COGNITIVE SKILL

Various behaviours are deliberated by cognitive skills such as stateful, which can track all states typically which is needed appropriately. Manipulation is an important behaviour that, using symbolic reasoning, is involved in manipulation of explicit semantics. The operation of human-level is involved in human legibility. All kinds of internet cognitive capabilities are implemented in ORO knowledge-based systems that can maintain the discussion part of the situation assessment module SPARK, symbolic task planner HATP, dialogue processor DIALOGUE, and at last execution controller, SHARY and PYROBOTS are joined in this model.

5.1 Internal cognitive skill: internal cognitive characteristics are tightly bound with knowledge models. This cognitive silk is implemented directly in the ORO server. Three internal cognitive skills are provided here such as the theory of mind modelling, approach to memory management, and reasoning.

Symbolic reasoning: to reason knowledge box PELET open source reasoner is used widely. Several standard interference mechanisms such as concept satisfiability, realization, consistency checking, and classification are supported by symbolic reasoning. Reasoner is involved in explaining during the time of logical inconsistency. To identify differences and similarities between concepts various algorithms of symbolic reasoning are implemented in the ORO server (Khandelwal et al. 2017). Given sets of individuals are specified by a high performing Common Ancestor algorithm. Common Ancestor algorithm is able to differentiate two important concepts such as clarification and discrimination. Robots collect common-sense ontology and other knowledge with the help of perception and proactive questing of human partners.

Theory of Mind: the theory of mind is a cognitive skill that maintains the mental state of another agent, mainly knowledge of the subject's model is maintained by this cognitive skill. The interactive perspective of a robot is maintained by theory of minds such as the robot's ability to store and build. The ability to retrieve separate models of belief of the human is maintained by this theory of mind. This factor is involved in the maintenance of human interaction with robots (Haring et al. 2018). Various mechanisms are used during the implementation of the theory of minds. For example, high-performing mechanisms help this cognitive skill to detect the appearance of new humans. A new independent knowledge model is implemented for human agents.

Working memory: Length of cognitive psychology and neuro-psychology communities is measured by this working memory. The idea of short-term and long-term memory is evaluated by this cognitive skill. SOAR architecture can reproduce human-like memory organization. Besides, the GLAIR cognitive consists of long and short term and episodic and semantic memories. Three profiles are predefined such as short term, episodic, and long term memory. These profiles are attached with different lifetime for the statement, however, this statement is removed automatically after a proper time. This is a limited approach, where episodic memory primarily refers to the semantic of the statements.

6. USE OF AI FOR HUMAN-ROBOT INTERACTION

Computers had already changed the world by able to perform calculations and store data at an obscenely high rate. The computers quickly made old filing systems, calculation systems obsolete. The internet first became popular in the 1980s and the 1990s. The internet had the potential to change the world. The internet capitalized their potential by connecting computers to one another. Computers had already changed the world by being able to perform infinite jobs (Olaronke et al. 2017). The internet allowed the computers to talk to one another with the help of the internet. The most important aspect of any technology to overcome any hurdle is comprised of mainly two things. The first hurdle being the processing power and the second hurdle being its size. As time went by the engineers made computer components so fast and so simple that they could fit into the hands of a person.

Devices like the ARDUINO and the raspberry pi are ground breaking. This is because although devices such as these existed before they had never been this simple and this easy to use. In the present day and age with WIFI chips are so small and miniaturized that a person can easily connect an ARDUINO to the internet. Presently with objects so powerful, even tiny objects could be made smart. Previously only big and clunky computers could use the internet. Presently even devices such as the smartphones and devices such as google glass can use the internet (Olaronke et al. 2017). The internet of things is being able to connect things to the internet. Now with the help of a smartphone the information whether the chair is occupied or not along with the information of the identity of the person sitting on the chair can be found out from anywhere in the world. Instead of the chair if there is an appliance or a machine or even a vehicle then that can be controlled from anywhere in the world (Kompatsiari et al. 2017). This is done using various embedded chips and circuits that are getting smaller and cheaper every day.

In order to turn the machine into a smart machine in the AI the processes that have to be followed are given as follows:

- Firstly the machine has to be given a unique identity. So that the particular machine can be identified as opposed to all the other machine in the world. The current addressing protocol IPv6 (Internet Protocol version 6) gives unique identities without practical limit. Anything people can conceive of in the planet or even off it that people might want to put on AI that will be able to get a unique identity.

- Then the machine has to be given the ability to communicate. Preferably wireless communication has to be given in this day and age (Ghazali et al. 2018).

- The third step in order to turn the machine into a smart machine in AI is that the chair has to be given senses. Sensors need to be put in the chair that will give some information either about the chair or about the environment. In this case a pressure sensor is put on the seat in order to know whether the chair is occupied or not.

- An **RFID** (radio frequency identification) tracker is put in the chair in order to identify the person sitting on the chair.

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7. WAYS TO CONNECT AN ARDUINO TO THE INTERNET

There are numerous ways to connect the ARDUINO to the internet. Some of them are:

- A person can purchase an ARDUINO UNO and with it purchase a WIFI shield or breakout board and just stack it on top of the board.
- The ARDUINO board with a built in WIFI system can also be brought. The example of such boards are the ARDUINO YUN or the MKR series
- Third party OSP boards can also be bought such as the ESP 660.

The internet of things and robotics, both of them are synergies. Both the internet of things will benefit robotics and the robotics in turn will benefit the internet of things. Building robots required dozens of hours and schematics. The internet of things enables multiple small robots to work together for a larger project. Robotics moves from pure automation which involves sensing and acting to mobile communication which include the communication and collaboration (Thill and Ziemke 2017). The application of the internet of things in robotics allow the creation of intelligent systems which enable systems or more specifically robots to sense the environment. The application of the internet of things also allow robots to think based on the sensor input, communicate, collaborate and act. The internet of things also enable robots the features of autonomy and mobility. The application of the internet of things allow the creation of smart devices which can sense, think, communicate, collaborate and then act based on that data. This is very different from the internet. Over the last few years there have been inventions in the mobile communication field that have directly supported the robotics industry and sector. Most of those things have to do with accelerometers or low cost cameras. Some of the technologies from the robotics industry have actually helped the mobile communication industry. For example the facial recognition technology and natural language processing. Therefore these technologies are highly synergetic and they are supporting each other. In the case of the internet of things there are three classes of edge devices. These are as follows: -

- Thin devices, which are interacting with the people. In these devices there is a minimum delivery of sensing and communication. The computational work takes place on the distant servers. The device level programming that is present is limited or non-existent
- Intelligent devices, which has some level of intelligence. These kinds of devices also provide for a level of intelligence in the terms of processing. These kinds of devices are reprogrammable and they can even exhibit varying level of autonomy. The more serious work in this case occur in the remote servers (Yang et al. 2017).
- Actuated devices which not only include sensing, processing and communication but they can also operate in the real world. These kinds of devices combines the work of the above two devices, namely the thin devices and the intelligent devices. This is also a fact that in some sense these devices are also robotic.
- The actuated devices are of two types Static and Dynamic. The Dynamic actuated devices enable the features of movement, mobility and manipulation along with artificial intelligence which is abbreviated as AI and robotic devices.

These technologies have been with robotics since its inception including the processing of host servers and the typical things such as autonomy manipulation, mobility and such. Most of the robots use in the internet of technology work on passive sensors which are common to the internet of things edge devices (Kennedy et al. 2017). These devices receive their operating power from outside sources such as electricity. These sensors also include the battery assisted passive sensors and the assisted semi passive sensors.

8. CONCLUSION

The AI allows a lot of data to be collected, turn it into wisdom and in turn move the human race forward. This is evident by the use of technologies such as google flu. The disadvantage of the internet of things is its security factor, privacy factor and its complexity. The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it. The application of the internet of things also allow robots to think based on the sensor input, communicate, collaborate and act. AI also enable robots the features of autonomy and mobility. The application of AI allow the creation of smart devices which can sense, think, communicate, collaborate and then act based on that data. This is very different from the internet. Over the last few years there have been inventions in the mobile communication field that have directly supported the robotics industry and sector. Therefore these technologies are highly synergetic and they are supporting each other.

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